The Spread of Feed-In Tariff Legislation in Europe: A Diffusion of Innovation Study

By

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ABSTRACT

Environmental policy has become increasingly important as states attempt to curb negative environmental impacts and adopt a more a sustainable economic approach that relies on alternative energies instead of fossil fuels. Many countries have adopted policies to foster the production of renewable energy, chief among them feed-in tariffs (FiT) and renewable portfolio standards (RPS). Extensive study as to the pros and cons of both of these approaches has been done using a multitude of methodologies, but little research exists that examines why states choose one approach over the other. This paper seeks to address this gap in the existing research by exploring the following question: why have some European states adopted FiT legislation and others not? I test the primary model for state policy adoption – the integrated diffusion of innovation (DOI) model – in order to determine the extent to which this theoretical approach applies in an EU context. I use event history analysis to examine FiT legislation adoption in order to identify patterns and traits of those most likely to employ FiT. Using existing DOI literature as a guide, I test several internal determinants – problem severity, energy dependency, wealth, ideology, and interest group pressure – as well as spatial diffusion to understand the determinants of FiT legislation adoption. My results suggest that regional effects strongly influence FiT diffusion in Europe, while internal determinants are less likely to predict policymaking. To conclude, I offer suggestions for future research in this area.

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INTRODUCTION

The political importance of renewable energy (RE) policy has risen dramatically over the last few decades. As the threat of global warming brought on by greenhouse gas emissions looms, many countries, particularly those in Europe, have encouraged the domestic production of renewable energies such as wind, solar, hydro, and biomass power (Hill, 2010). Most of these policies can be broadly categorized into one of two forms: feed-in tariffs – price supports for RE that are particularly prevalent in Europe – and renewable portfolio standards – RE quotas for utility companies that are more common in the United States. While extensive study of the consequences of these policy alternatives exists (Danchev, Maniatis, and Tsakanikas, 2009; Williges, Lilliestam, and Patt, 2010; del Río, 2010; Butler and Neuhoff, 2007; Toke, 2006; Fouquet and Johansson, 2008; Campoccia et. al., 2008; Traber and Kemfert, 2009), little analysis regarding the motivations of states in choosing one policy over the other has been undertaken. Some quantitative analyses of environmental policy adoption within the US using DOI theory exist (Chandler, 2009; Matisoff, 2008; Daley, 2007), but comparable evaluation of feed-in tariff adoption in Europe has yet to be explored. Research into this field is a logical next step; does the integrated DOI model explain the proliferation of feed-in tariff legislation in Europe?

Most of the current legislative action to promote RE production and limit the release of greenhouse gases has been done at the national level or lower. Although the Kyoto protocol established a large global consensus regarding a desire to reduce greenhouse gas emissions, the lack of US participation in the treaty limited its effectiveness. More recently, US and Chinese opposition to a new, international RE framework at the summit in Copenhagen in 2010 further stifled environmentalists' aspirations to create transnational cooperation in this legislative area. Due to this lack of supranational teamwork, individual states are left to create and tinker with

their own unique policy ideas. As a result, states have considered and adopted a variety of policies to address climate change and fossil fuel dependence. Many European states have chosen to adopt FiT legislation. Most states in the US, however, have decided to adopt RPS policies. Some countries in the world, such as China, opt for no formal policy approach. In any case, much of the European continent has selected a relatively similar policy course, while the US and other countries of the world try other approaches or do nothing. This paper seeks to explain why European countries have been nearly unanimous in their acceptance of FiT legislation.

As this paper explores the state motivation of policy adoption, it also provides insight into an adjacent area of study. A variety of research on management of common pool resources contend that population increases deleteriously affect common resource management (Ehrlich, 1968; Malthus, 1960) and that smaller groups are better able to manage shared resources than larger counterparts (Olson, 1965). Others dispute a directly linear relationship between population and environmental stewardship (Leach and Mearns, 1996), but a large consensus in the literature supports the claim that commonly shared resources are neglected in terms of sustainable management (Hardin, 1968). This paper helps to explain why states choose to adopt policies regarding the management of a common pool resource. Contrary to what previous researchers have asserted, the salience of the environmental objectives of increasing RE production and improving sustainability have increased along with the population. FiT legislation represents a new way of better managing the common resources of air quality, sea level, and species protection. In the absence of a binding supranational framework, understanding why the states of Europe voluntarily adopt a legislative policy that will spread environmental benefits to non-participating countries while its economic and associated costs

will be borne almost exclusively domestically is important. Many of the benefits of adopting FiT legislation are diffuse - the air, land, and water is cleaner for all states, not just those who adopt the legislation - but the costs are concentrated - only enacting states pay the price supports to help foster RE. Prevailing opinion holds that this should not happen, but clearly something causes EU states to adopt this policy goal. Research into this decision therefore provides some understanding as to how and why common pool resources may be better managed.

To test DOI theory, I utilize event history analysis to examine the relative impact of important demographic, ideological, and economic factors influencing policy adoption in European countries over time. This data are drawn from EUROSTAT, an EU agency that is tasked with compiling information on EU member states, the European Election Database, a compilation of election results for EU members over time, and the European Green Party website which contains detailed information about that interest group and its electoral history. The outcome of the my analysis represents a somewhat surprising departure from most of the literature in that I do not find that internal factors play an especially strong role in a state's decision to adopt FiT legislation. Instead, regional diffusion is a consistent predictor of policy adoption.

In the next section, I review the current literature on DOI theory as well as the topic of FiT. I use this information to formulate hypotheses as to what indicators should be tested in my analysis, and I articulate the hypotheses at the end of the literature review section. In the methods section, I explain how I operationalize the indicators I have selected as well as the data sets available. Next, I explain the results of the event history analysis and provide a table of results for the three models I test. Finally, I offer concluding remarks about the results of my analysis as well as suggestions for future research.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Internal Determinants and Regional Diffusion Literature

Diffusion of innovation theory seeks to explain why states choose to adopt policies. According to this theory, there are two primary motivations that predict government action, internal determinants and regional diffusion (Walker, 1969; Berry and Berry, 1999). Internal determinants include characteristics within a state, such as its citizens' ideology, governmental structure, economic situation, natural resources, etc., that influence its decision to act politically. Extensive research using diffusion of innovation theory has been done, and a variety of important internal determinants have already been identified. These include, but are not limited to, interest group pressure and speed of government action (Daley, 2007), citizen demands (Matisoff, 2008), socioeconomic level and predominant governing ideology (Chandler, 2009), the election cycle and economic crisis (Berry and Berry, 1992), and the social stratification of the populace coupled with a state's fiscal outlook (Filer, Moak, and Uze, 1988). This is not an exhaustive review of all DOI research that has identified important internal indicators, but it is reflective of typical findings when internal determinants are especially salient. These factors are not always found to be particularly predictive. Instead, the existing research provides a guide of certain traits that are useful to understanding state action for certain policies. In this regard, DOI research undertaken that relates to environmental policy adoption is especially useful and shows that factors such as interest group pressure, citizen demands, as well as state affluence and ideology, should be included in this analysis (Daley, 2007; Matisoff, 2008; Chandler, 2009).

Regional diffusion of policies is the other main explanatory factor in DOI theory. Regional diffusion explains a state's decision to adopt a policy by examining the presence of the policy or something similar in a neighboring state or nearby region. In some circumstances,

states may enact legislation not because of their internal traits, but out of competition or emulation of their neighbors. Numerous studies demonstrate the importance of regional factors in explaining a state's decision to adopt a particular policy. These include, but are not limited to, renewable energy legislation (Chandler, 2009), tax policy (Berry and Berry, 1990), and terrorism responses (Chamberlain and Haider-Markel, 2005). The diffusion of a policy can occur in a direct fashion in which the legislation spills over to adjacent neighbors or spreads through a particularly distinct region. The aforementioned studies provide an example of this type of diffusion. Other analyses of DOI theory and its spread identify an additional important type of diffusion known as hierarchical or leader-laggard diffusion. Hierarchical diffusion occurs when a policy diffuses from a particularly powerful hegemon down to less influential states. This related but distinct form of diffusion has empirical support in studies of policy spread within the United States (Walker, 1969; Freeman, 1985) and internationally (Collier and Messick, 1975). Regardless of the particular type of diffusion, the broad theoretical underpinning of the motivation for policy spread remains the same. States take legislative action due to interaction with, and experimentation of, external actors. They learn from their neighbors and, in some cases, compete with them as a result of policy decisions. These activities influence states to act, even if certain domestic stimuli are absent.

Extensive research of DOI theory has found explanatory factors that are not easily categorized into the internal determinants or regional diffusion classifications. Studies show that interstate professional associations (Balla, 2001), policy entrepreneurs (Grinstein-Weiss et. al., 2009; Mintrom, 1997; Mintrom and Vergari, 1998), federal incentives or other vertical governmental forces (Savage, 1985; Shipan and Volden, 2006; Welch and Thompson, 1980), the nature of the policy (Savage, 1984; Canon and Baum 1981; Mooney and Lee, 1995), and cultural

effects on institutions (Strang and Meyer, 1993) all influence a policy's spread. These studies represent an important contribution to DOI theory and understanding policy diffusion. As a first attempt to apply DOI theory to an EU context, I focus on the direct internal determinants and established understandings of regional diffusion.

Statistical analysis of data sets has evolved greatly since the first forays into DOI research were done. Early study of policy diffusion did not include event history analysis (Walker, 1969). For this reason, other researchers were critical of the utility of DOI theory, primarily for its inability to accurately gauge the importance of regional effects in policy spread (Gray, 1973). Statistical analysis has improved significantly over time, allowing more accurate testing of the theory (Berry and Berry, 1999). The current model utilizes event history analysis in order to test the relative importance of regional effects and internal determinants on policy adoption.

DOI theory has been tested in a variety of substantive areas, including: lottery adoption (Berry and Berry, 1990; Filer, Moak, and Uze, 1988), tax policy (Berry and Berry, 1992), electricity deregulation (Andrews, 2000), terrorism responses (Chamberlain and Haider-Markel, 2005), and educational reforms (Mintrom and Vergari, 1998; Renzulli and Roscigno, 2005). International literature using DOI theory exists, but it has been more limited in its application and scope. International DOI research focuses largely on the diffusion of much larger topics such as neoliberal economic policies (Simmons and Elkins, 2004; Simmons, Dobbin, and Garrett, 2006; Levi-Faur, 2005) and democracy (Wejnert, 2005). Very limited research of the international dynamic and its influence on policy diffusion exists (Meyer et. al., 1997; True and Mintrom, 2001), and it does not analyze a specific policy's spread across sovereign states. The subject of this paper fills an important void in the current literature by analyzing DOI through both the uniquely federal EU structure and across countries. Whereas previous research is limited

largely to application within the United States or has been applied very broadly in an international context, the research in this paper transcends these barriers. I test an established theory in a new setting to determine its explanatory power in a comparative nation-state setting. By doing so, understanding of DOI theory expands and new avenues for critique and improvement of the theory open up.

Feed-in Tariff and Renewable Portfolio Standards Literature

Feed-in tariffs guarantee all renewable electricity generators access to the utility grid and require utility companies to purchase electricity from these producers at mandated rates that are set above market value and vary based upon the method – hydro, solar, wind, etc. - by which the electricity is generated. The differences in payouts are designed to account for variations in prices of production; the goal is to ensure that all generators of renewable energy can expect a modest profit for the energy that they produce, regardless of method used. The utility company then usually increases rates to all electricity consumers in order to pay for the more expensive renewable energy that is being fed into the system. These price supports for renewable energy producers are guaranteed by the government for a specific period of time – from as little as eight years to as many as twenty – to provide confidence for potential energy generators to make the investments necessary – such as purchasing photovoltaic cells for solar energy production or turbines for wind energy – to produce. Most feed-in tariff payouts also diminish over time. This serves as a dual incentive for investors to begin producing renewable electricity sooner and to encourage electricity generation to become cost-effective and not remain payout dependent in perpetuity.

By comparison, renewable portfolio standards – more widely used in the US - are government requirements on utility companies to either generate or purchase a certain percentage

of their energy from renewable sources. Utilities are forced to buy certificates that correspond to an amount of energy produced and must accumulate enough certificates to meet the government mandated quota, which is proportional to the amount of overall energy that they transmit. Certificates are tradable among utilities in order to not overly penalize or reward companies that have certain geographic or infrastructural disadvantages or advantages in terms of renewable energy acquisition. Transfer of certificates also creates a self-regulating market for their use. Utilities that do not obtain enough certificates pay penalties that are recycled to companies that do meet their renewable energy quota, thereby increasing the incentive for compliance.

Most academic research into FiT and RPS legislation is evaluative and focuses on the outputs of the policies in the implementing countries. This body of literature examines aspects such as the internal rate of return on photovoltaic investments under FiT legislation in Greece (Danchev, Maniatis, and Tsakanikas, 2009); cost competitiveness of RE under FiT as compared to non-renewable sources (Williges, Lilliestam, and Patt, 2010); energy efficiency improvements under RE promotion regimes (del Río, 2010); the pay-back period, net present value, and internal rate of return for different PV and wind systems (Campoccia et. al., 2008); changes in deployment and costs (Butler and Neuhoff, 2007; Toke, 2006; Fouquet and Johansson, 2008); and changes in consumer costs versus producer costs (Traber and Kemfert, 2009). Additionally, a significant portion of the evaluative research shows that specific policy design has a profound impact on the achievements of RE promotion legislation (Ringel, 2005; Ohl and Eichhorn, 2009; del Río and Gual, 2004; Lipp, 2007); coordinating RE objectives between state and federal governments significantly influences the ability to meet policy objectives, as does the specific setting of the price support and its duration. Altogether, this body of literature contributes greatly to our understanding of policy implementation and impact. The variety of methods used to

evaluate the legislation as well as the diversity of the impacts that are analyzed provide invaluable information on FiT and RPS policies. The utility of these analyses are limited, however, in that they do not substantively examine why states choose to adopt the RE policies that they do or why they implement any RE legislation at all.

Research into the motivations for FiT and RPS adoption has been undertaken, but it is much more limited in number than the evaluative research. Case studies into Texas's decision to adopt RPS (Hurlbut, 2008) and Germany's choice to employ FiT (Lauber and Mez, 2006) are particularly informative, but the nature of the case study prohibits widespread application to other implementing states. Non state-specific study into the spread of FiT policies in Europe exists (Söderholm and Klaassen, 2006; Eikeland and Sæverud, 2007), but it has a few weaknesses. Söderholm and Klaassen only examine the diffusion of wind power legislation – which is only one of many sectors affected by FiT and RPS designs – and both studies fail to examine regional effects. Although they provide valuable insight, they are not informed by theory and they neglect important external factors that might influence a state's decision to adopt a policy.

Other studies provide overviews of various government policy designs to foster RE generation (Ackermann, Andersson, and Söder, 1997), examine potential US benefits of implementing adopting FiT (Michel, 2007), discuss harmonization of RE policies in Europe and with the EU's goal of liberalizing electricity markets (Meyer, 2003; Verbruggen and Lauber, 2009), and the constitutionality of FiT policies in the US (Perkins, 2009; Ferrey, Laurent, and Ferrey 2010). This research is an important corollary to the studies mentioned above, as these analyses examine the long-term political sustainability of RE generation legislation. The European Commission is intent on creating a European single market for economic exchange,

and its goal is to incorporate energy production in this broader framework. Currently, most energy production remains nationalized, and only a small percentage of energy is sold across borders. Contentious political debate often surrounds FiT legislation, as opponents claim that it is anathema to markets or fair, inter-state competition. Additionally, as FiT legislation has diffused throughout Europe, it has gained popularity in other regions of the globe, including the US. As states increasingly turn to this method of fostering RE production, scrutiny of impacts and its compliance with the Constitution will likely increase (Perkins, 2009; Ferrey, Laurent, and Ferrey 2010). These studies are particularly helpful in examining the potential future of FiT and RPS legislation, but they are limited, because they do not examine the important past regarding states' decisions to enact FiT or RPS legislation. My research is an attempt to address this incomplete part of the literature.

Hypotheses

The current literature on DOI theory and the topic of RE legislation suggest several hypotheses as to what indicators are likely to influence a state's decision to implement FiT legislation.

Internal Determinants:

(1) States are likely to be responsive to problem conditions. States that rank poorly on indicators such as air quality, water quality, and environmentally induced health difficulties are more likely to encourage renewable sources of energy.

(2) States that are dependent on fuel sources from foreign countries are more likely to support RE generation initiatives. Many states consider energy dependence as a threat to national security, so threatened states should have a greater impetus to enact legislation to limit this threat.

a. States that have a strong fossil fuel sector are less likely to adopt RE legislation. In democratic states, interest groups are allowed to lobby and try to influence elected leaders. In states where non-renewable interests are financially and politically connected, the government will not likely implement a RE promoting initiative.

(3) States in which citizens are more ideologically liberal are more likely to support FiT legislation. FiT policies are perceived as being more command-and-control in nature than their RPS counterparts. States that have citizens who are more likely to embrace strong federal *dicta* regarding policy initiatives related to achieving environmentally friendly objectives will be more receptive of the FiT approach.

a. More conservative states are less likely to adopt FiT policies and instead will embrace a RPS approach or no RE promotion scheme at all. RPS policies are perceived as being friendlier to free-markets than FiT legislation. States that emphasize small government or minimal government interplay with the economy are therefore less likely to support FiT.

(4) States that have an influential Green party are more likely to adopt RE legislation. RE initiatives in many European states were introduced by Green parties. These groups advocate environmental consciousness and sustainability, so states with a large Green presence will embrace FiT.

(5) Wealthier states are more likely to enact FiT legislation. FiT ensure cash payouts to RE generators and can lead to electricity price increases. States with populations who are better off financially are more likely to support this policy design than states with poorer populaces.

Regional Diffusion:

(1) States are more likely to adopt FiT legislation if neighboring states also do so. States are cognizant of the actions of their neighbors, and in an effort to remain competitive with those countries, they will often mimic policy initiatives that they believe are beneficial.

METHODS

I use event history analysis to identify which variables have a particularly salient predictive value in states' decisions to adopt FiT legislation. This approach is well-grounded in DOI and international relations literature (Bennett and Stam, 1996; Berry and Berry, 1999; Box-Steffensmeier and Jones, 1997). In event history analysis the dependent variable is coded dichotomously and drops out after a state adopts FiT legislation. This allows analysis of data leading up to the point of adoption, while dropping out data post-adoption. Motivation for state action is better evaluated through this method. I chose event history analysis instead of a simple logistic regression, because I could not find any instance of a state adopting FiT and later abandoning it. I obtain the data used in this analysis from EUROSTAT, a statistical collection agency affiliated with the European Commission, the European Election Database, and the European Green Party website. The data available for each variable are not uniform; some data sets date from 1990 to the present, while others are for shorter time frames. The overall temporal scale for the analysis is 1990 to the present. Table 1 offers a brief synopsis of each measure and a description of its calculation.

[Insert Table 1 Here]

Problem Severity

I use emissions of acidifying substances as a measure of a state's environmental health.

This data set dates from 1990-2006. It is also available on a sector-by-sector basis (energy, manufacturing, transport, etc.), but I use the aggregate measure in my analysis, because the aggregate better quantifies the problem threat. The specific source sector is irrelevant in evaluating the health effects on the populace; more important is the overall health threat. These acidifying substances have deleterious health effects (WHO, 2011), and the presence of these pollutants should therefore give states reason to promote RE.

Energy Dependency

For this model, I collect information on each country's energy dependency on coal, oil, and natural gas. The data date from 1998-2008. This measure calculates the amount of imported energy an economy needs to continue to function. A more perfect measure would incorporate rhetoric or public sentiment toward each imported energy source. For example, natural gas from Russia and oil from the Middle East are often cited as problems in terms of EU member state safety. An aggregate measure of the amount of these imported energy sources is not perfect, but it does represent an important baseline in understanding security threats tied to energy sources.

Ideology

In order to measure citizens' political ideology, I use election results from each of the member states. I input the total vote percentage vote won by the social democratic parties of each state. I gather this data from the European Election Database, and, in order to be consistent, I use the categorization offered by the website. Any party identified as "social democrat" or "democratic socialist" was included in my study. Some states have multiple social democratic parties, while others have none. For states that had multiple social democratic parties in power simultaneously, I add the total percentage votes for each of the parties together to form a single measure. All other parties were excluded from my analysis. I assume that states that have higher

vote totals for social democratic parties are more liberal.

Interest Group Pressure

In this model, I analyze Green party election results in EU member countries over time. The Green party is dedicated to promoting environmentally sustainable economic initiatives and encourages environmental protection. The data I use is obtained from the European Green party website. Data is not uniformly available for all EU member countries, as elections are held in varying cycles and the Green party has not existed in all EU states for the same duration of time. I use the total percent of the vote won by the Green party.

Wealth

For this model, I use real GDP per capita and net national income. The data set for GDP ranges from 1995-2010 and for net national income it is from 1990-2009. GDP measures goods, services, and products that are produced by general government and non-profit institutions within each member state. This number is then divided by member state population. Net national income measures all state income minus income earned from external actors and payments made to external actors. Taken together, these two measures provide an accurate snapshot of a state's socioeconomic level and thereby identify wealthier countries more likely to adopt FiT legislation.

Diffusion

In order to test diffusion effects, I code EU member states "0" or "1" over the 20 year period for which I have data. Member states are coded as "0" for years that they have not adopted FiT legislation or "1" for years in which they have adopted FiT. I obtain dates for each country's adoption from the Institute for Building Efficiency, a research group that promotes eco-friendly business solutions. To create a diffusion measure, I count the number of states that

have adopted FiT as of that year. I then subtract the state of analysis; this is represented by 1. Finally, I divide that number by the number of other member states of the EU, 26, yielding the value used for diffusion for that country. This results in a variable that measures average diffusion pressure over time. The formula is provided below, and Appendix 1 provides the date of adoption for each EU country.

$$f=(x-1)/26$$

RESULTS AND DISCUSSION

Table 2 provides descriptive statistics for the variables used in this analysis. The results of the event history analyses can be found in Tables 3-5. Contrary to many studies in DOI literature, in all of my models internal determinants were not statistically significant predictors of state adoption of FiT. Diffusion effects, conversely, were significant in all models.

[Insert Tables 2-5 here]

Surprisingly, none of the internal determinants proved particularly salient in the models. This runs contrary to much of the research done using DOI theory and is largely counterintuitive. States with poor air quality are as likely to promote RE as states with clean air. Energy independent states adopt FiT just like their energy dependent counterparts. Ideology, interest group pressure, and state wealth are similarly no more or less likely to adopt FiT. Two things explain these results. First, the data sets for the variables I selected may not provide a sufficient time frame to analyze this diffusion process. Ideally, the data available would be for a time frame longer than 20 years. Second, European states may be much more similar than the states in the US. The very close proximity of the member states and their populations, coupled with EU directives to harmonize living conditions in the Union may make study of policy diffusion incompatible with current methodology. Obviously there are very real, observable differences in

many of the measures I use in this study, but the overall range of these values simply may not be great enough to identify statistical significance of the kind that is possible when comparing paradoxically different states and regions in the US.

The only reliable predictor in the analyses is diffusion, and the relationship between state adoption of FiT and diffusion is particularly strong in all models. These results suggest that the states of Europe are very responsive to the actions taken by their neighbors even when a domestic impetus for legislation is lacking. Again, this is a surprising finding for those who specialize in DOI research, and it offers an equally interesting contribution to common pool resource research. The management of the common resource of environmental quality is not being done voluntarily in Europe by states choosing to bear a cost while others could potentially free-ride. Instead, a strong diffusion effect within the EU ensures that member states follow a policy prescription that gains momentum. States adopt a policy protecting common resources, because they are confident that other states will follow suit and because other states have already done so. This minimizes the risks associated with adopting policies that would otherwise be cost-prohibitive or economically disadvantageous while simultaneously providing incentive for states to be creative policymakers. States that come up with a progressive idea can be confident that they will be a trendsetter for their successful policy design. This strong diffusion effect overcomes the traditionally held self-interest that precludes innovative management of common resources. Indeed, the cooperative nature of states in the EU relative to those in the US may explain the divergence in results when applying the DOI model to policy adoption. While European states have become increasingly integrated and apt to mirror the policy designs of their neighbors, the political environment in the US has become increasingly combative. A resurgence of states' rights in the US and a desire to increase state power while minimizing federal influence

would explain the emphasis on internal determinants found in the US while European states are simultaneously more influenced by regional forces.

CONCLUSION

This paper tests the integrated DOI model and applies it to a new geographical region, the EU, in order to identify important predictors for why states choose to adopt a RE promoting policy. The results suggest that internal factors are not important in states' decisions to introduce a RE program. This is a surprising finding that runs contrary to a significant body of previous research in which internal determinants are found to be particularly salient. This may be a result of the limited time frame available for some of the data used, or it could be a consequence of a more closely clustered, homogeneous political entity relative to the US. Instead, this research shows that regional pressure from other states in the EU is the primary force behind states' choices to adopt and what motivates states in the EU to manage common pool resources in circumstances where they may not otherwise. In this respect, proximity and similarity between states fosters policy adoption as EU states are more cooperative and likely to mimic the actions of their neighbors. In the EU, states are more like one another, and they are therefore more likely to embrace the policies adopted by one another.

Some of the limitations of this study have been discussed above and include the time span, selected variables, and my inability to measure certain diffusion effects. I would prefer a data set longer than 20 years, and some variables used had particularly short durations available. Over time, the data made available on EUROSTAT should only increase, and a longer time frame should only help diffusion studies of this nature. Additionally, I wanted to incorporate hegemonic and hierarchical diffusion measures, but I was unable to successfully integrate those data sets into my regression analysis. A successful attempt in this regard would provide a good

supplement to my research by providing a more nuanced understanding of the diffusion effect taking place in FiT diffusion.

Future research should continue to test the integrated DOI model on the EU in order to determine if state motivation for policy adoption better mirrors results found in US applications or, as I found in my study, the results continue to diverge from one another. This research could continue to examine environmental policies and their spread or diverge into other areas such as tax policy, education policy, etc. Additionally, DOI research should continue to branch out and increased study of policy diffusion across geographic and political regions such as the African Union and ASEAN should be undertaken. Only through increased international analysis of DOI theory will we gain understanding of its strengths and weaknesses as a model, and it is important to continue to test this theory on a variety of political organizations. If researchers continue to find divergent results, it will be necessary to try and understand why. Is this theory not directly applicable to other regions outside the US? Or do different political entities simply not respond to the same impetus as the states in the US? If not, why not?

This research benefits a variety of actors. First, it contributes to DOI theory and common pool management research. Second, it benefits policymakers and government parties interested in understanding the drivers behind state action. Third, it aids lobbying interests, including environmental advocates and those affiliated with industry, that obviously have a vested interest in influencing policy adoption in their respective favor. DOI research impacts a diverse set of interests and continued study in this area would be of benefit not only to academia but a variety of actors in government.

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Table 1. Independent Variable Descriptions

Independent Variable	Description
Problem severity	
Emissions of acidifying substances	This indicator tracks trends in anthropogenic atmospheric emissions of acidifying substances (sulphur dioxide, nitrogen oxides and ammonia) by source sector. Acidifying substance emissions are combined in terms of their acidifying effects, and expressed in acid equivalents. (EUROSTAT)
Energy dependency	
Reliance on imports	The indicator is calculated as net imports divided by the sum of gross inland energy consumption plus bunkers. (EUROSTAT)
Ideology	
Social democratic party	The European Election Database provides classifications of political parties according to the recognized Manifesto Project dataset. (European Election Database)
Interest group pressure	
Green party	European Green party election results are compiled by the party for each election cycle.
Wealth	
GDP per capita	GDP includes goods and services that have markets (or which could have markets) and products which are produced by general government and non-profit institutions. Real GDP per capita is calculated as the ratio of real GDP to the average population of a specific year. (EUROSTAT)
Net National Income	Gross national income (at market prices) represents total primary income receivable by resident institutional units in return for some engagement in productive activity: compensation of employees, taxes on production and imports less subsidies, property income (receivable less payable), gross operating surplus and gross mixed income. (EUROSTAT)
Diffusion	Year of feed-in tariff adoption for each member state.

Table 2. Descriptive Statistics of Variables Tested

Variable	Obs	Mean	Std Dev	Min	Max
Problem severity					
Emissions of acidifying substances	459	3417.431	4260.121	6	21852
Energy dependency					
Reliance on imports	297	468.101	327.3827	-508	1025
Ideology					
Social democratic party	567	2064.025	1815.161	0	7800
Interest group pressure					
Green party	377	47.20424	132.3688	1	1158
Wealth					
GDP per capita	400	17310.25	12188.89	1500	61200
Net National Income	458	751.7795	243.7663	74	1032
Diffusion	366	0.26219	0.236671	0	0.769231

Table 3. Determinants of FiT adoption (Full Model)
(Logistic Regression)

Variable	Coefficient	Std Error	
Problem severity			
Emissions of acidifying substances	0.000184	0.00049	
Energy dependency			
Reliance on imports	-0.00375	0.00492	
Ideology			
Social democratic party	0.000627	0.001258	
Interest group pressure			
Green party	-0.0149	0.079243	
Wealth			
GDP per capita	0.000131	0.000161	
Diffusion	49.01974	12.36484	***
N = 102			
Wald χ^2 = 18.37			
Prob χ^2 = .0054			

*Note: *, **, and *** represent significance at .1, .05, and .01 levels, respectively.*

Table 4. Determinants of FiT adoption (Reduced Model 1)
(Logistic Regression)

Variable	Coefficient	Std Error	
Problem severity			
Emissions of acidifying substances	0.000027	0.0003493	
Ideology			
Social democratic party	-0.0005333	0.000513	
Wealth			
GDP per capita	-0.0001004	0.0000946	
Diffusion	46.22145	6.476092	***
N = 202			
Wald χ^2 = 77.37			
Prob χ^2 = 0.000			

*Note: *, **, and *** represent significance at .1, .05, and .01 levels, respectively.*

Table 5. Determinants of FiT adoption (Reduced Model 2)
(Logistic Regression)

Variable	Coefficient	Std Error	
Problem severity			
Emissions of acidifying substances	0.0001386	0.0002807	
Ideology			
Social democratic party	-0.0008315	0.0006225	
Wealth			
Net national income	0.0052923	0.0079564	
Diffusion	36.9935	4.292118	***
N = 260			
Wald χ^2 = 86.21			
Prob χ^2 = 0.000			

*Note: *, **, and *** represent significance at .1, .05, and .01 levels, respectively.*

Appendix 1. Date of FiT Adoption for EU Countries

Country	Year of FiT Adoption
Austria	2002
Belgium	N/A
Bulgaria	2007
Cyprus	2003
Czech Republic	2002
Denmark	1993
Estonia	2003
Finland	N/A
France	2001
Germany	1990
Greece	1994
Hungary	2003
Ireland	2005
Italy	1992
Latvia	2001
Lithuania	2002
Luxembourg	N/A
Malta	N/A
Netherlands	N/A
Poland	2008
Portugal	1999
Romania	N/A
Slovakia	2003
Slovenia	1999
Spain	1994
Sweden	1998
United Kingdom	2010

Source: Institute for Building Efficiency, 2011